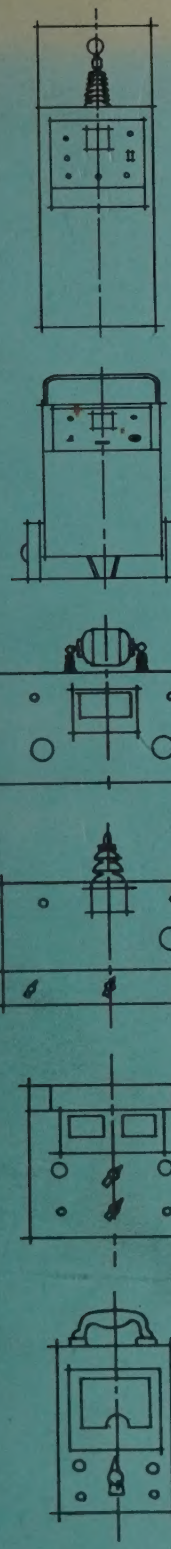
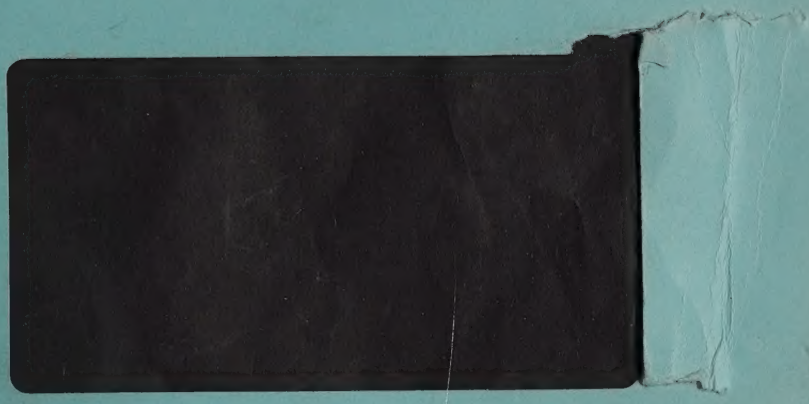
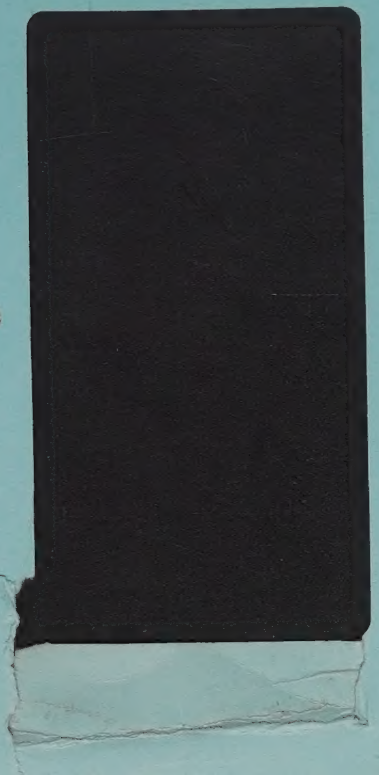
Electronic Services - Los Angeles
M11584X





MP MASTER
MA30109

ASSOCIATED RESEARCH, INC.
6125 WEST HOWARD STREET • CHICAGO, ILLINOIS 60648



OPERATING INSTRUCTIONS

MODEL 445 MOBILE AC HYPOT

0-3 KV @ 1.5 & 3.6 KVA
WITH BURN TEST

SAFETY

THE TEST OPERATOR MUST FOLLOW ALL ACCEPTED SAFETY PRACTICES, PROCEED WITH CAUTION, AND DO ALL IN HIS POWER TO ASSURE A SAFE TEST.

BECAUSE OF THE INHERENT DANGERS IN ANY HIGH VOLTAGE WORK, SPECIAL CARE MUST BE TAKEN TO SAFEGUARD PERSONNEL DURING ANY TESTING OR FAULT FINDING.

GENERAL

REGARDLESS OF THE TYPE TEST TO BE MADE OR FAULT TO BE FOUND, CERTAIN PRELIMINARY STEPS SHOULD PRECEDE THE ACTUAL TEST. FIRST, OPEN ALL SWITCHES AND BREAKERS TO DE-ENERGIZE THE CABLE OR EQUIPMENT AND ISOLATE THE ITEM. USING A HOT STICK AND RUBBER GLOVES, GROUND ALL SECTIONS OF THE TEST ITEM TO INSURE THAT IT IS NOT CHARGED.

CAREFUL ADVANCE PLANNING IS ESSENTIAL TO A PROPER AND SAFE TEST. PROPER TEST EQUIPMENT, GROUND LEADS, HIGH VOLTAGE CABLES, HOT STICK, RUBBER GLOVES AND ANY OTHER SPECIAL TOOLS SHOULD BE ASSEMBLED AT THE TEST SITE.

THE EQUIPMENT TO BE TESTED SHOULD BE DE-ENERGIZED, *PROPERLY GROUNDED AND DISCONNECTED. CABLES TO BE TESTED SHOULD BE DE-ENERGIZED, *PROPERLY GROUNDED, AND ISOLATED FROM OTHER COMPONENTS SUCH AS SWITCH GEAR, TRANSFORMERS, LIGHTNING ARRESTORS, ETC. BOTH ENDS OF A CABLE TO BE TESTED SHOULD BE DISCONNECTED AND PROTECTED TO SAFEGUARD PASSING PERSONNEL. THE CONDUCTORS AT THE FAR END OF A CABLE SHOULD BE SEPARATED AND TAPED TO AVOID EXTERNAL FLASH OVER OR LEAKAGE DURING THE TEST.

A MAN SHOULD BE STATIONED AT ANY POINT WHERE THE TEST ITEM IS ACCESSIBLE TO UNAUTHORIZED PEOPLE AND BARRIERS SHOULD BE ERECTED. SIGNS SHOULD BE POSTED THAT READ "DANGER - HIGH VOLTAGE TEST IN PROGRESS, KEEP AWAY." DO NOT USE TERMS SUCH AS "KILOVOLTS," "KV" OR "HV" BECAUSE THE AVERAGE PERSON DOES NOT UNDERSTAND THE TRUE MEANING OF THESE TERMS OR ABBREVIATIONS.

DECIDE UPON THE PROPER TEST PROCEDURE TO BE FOLLOWED BEFORE STARTING THE TEST.

HIGH VOLTAGE TESTING

AFTER MAKING ANY TEST TURN THE HIGH VOLTAGE SWITCH OFF AND RETURN THE VOLTAGE CONTROL TO ZERO OR MINIMUM POSITION, CHECK THE KILOVOLTMETER FOR A ZERO INDICATION (ON DC TEST THE CAPACITIVE ELEMENT OF THE TEST ITEM WILL HOLD A CHARGE AND MAY TAKE A LONG TIME TO DISCHARGE) AND *GROUND THE TEST ITEM BEFORE DISCONNECTION. AFTER A DC TEST HAS BEEN PERFORMED THE GROUND SHOULD BE LEFT ON THE ITEM FOR AT LEAST AS LONG AS THE TOTAL TIME HIGH VOLTAGE WAS APPLIED TO PREVENT A VOLTAGE BUILD UP DUE TO ABSORPTION CURRENTS. IT IS BEST TO LEAVE A GROUND ON A TEST ITEM ANY TIME IT IS NOT IN SERVICE OR UNDERGOING A TEST.

*ANY TIME A GROUND IS TO BE PLACED ON A CIRCUIT IT SHOULD FIRST BE GROUNDED WITH A HOT STICK AND RUBBER GLOVES. ALL CIRCUITS NOT IN USE (OR CONNECTED TO A GUARD OR BYPASS CIRCUIT) SHOULD BE GROUNDED.

FAULT FINDING

MAKE AN INSULATION RESISTANCE TEST ON THE FAULTED CABLE BETWEEN THE CONDUCTOR AND GROUND, SHIELD OR HOUSING BEFORE TESTING ON BOTH ENDS OF A CABLE TO DETERMINE THE CONDITION OF THE FAULT. CONSIDER ALL THE FACTORS EFFECTING THE FAULTED CABLE, SUCH AS THE RESISTANCE OF THE FAULT, THE AGE OF THE CABLE, THE CONDITION OF THE GROUND (IF BURIED), THE HUMIDITY, THE VOLTAGE RATING OF THE CABLE, ETC. AND DECIDE ON THE BEST TEST METHOD OR METHODS TO BE USED.

BECAUSE OF THE HEAVY PULSE CURRENT (POSSIBLY THOUSANDS OF AMPERES) GENERATED WITH CAPACITANCE DISCHARGE EQUIPMENT, IT IS ABSOLUTELY ESSENTIAL THAT CAREFUL ATTENTION BE PAID TO PROPER GROUNDING AND SAFETY PRACTICES. THE TEST EQUIPMENT SHOULD BE TIED TO A GOOD EARTH GROUND WITH AS SHORT AND HEAVY A CONNECTION AS POSSIBLE. THE UNUSED PHASES OF A MULTI-PHASE CABLE AND THE SHEATH OR NEUTRAL SHOULD ALSO BE TIED TO THIS SAME GROUND.

EQUIPMENT GROUNDING INSTRUCTIONS

IT IS ABSOLUTELY ESSENTIAL FOR SAFETY OF OPERATING PERSONNEL AS WELL AS FOR PROPER OPERATION OF THE TEST EQUIPMENT, THAT THE EQUIPMENT BE EFFECTIVELY GROUNDED. EFFECTIVELY GROUNDED, AS DEFINED IN THE NATIONAL ELECTRICAL CODE, MEANS "..... CONNECTED TO EARTH THROUGH A GROUND CONNECTION OF SUFFICIENTLY LOW IMPEDANCE AND HAVING SUFFICIENT AMPACITY TO PREVENT THE BUILDING UP OF VOLTAGE WHICH MAY RESULT IN UNDUE HAZARD TO CONNECTED EQUIPMENT OR TO PERSONS."

DEPENDING ON THE POWER INPUT REQUIREMENTS, SOME INSTRUMENTS MAY BE EQUIPPED WITH A POWER INPUT CABLE HAVING A THREE-PRONG GROUNDING TYPE PLUG, A TWO-PRONG PLUG WITH GROUNDING CLIP, OR A THREE CONDUCTOR CABLE TERMINATING IN LUGS (WHERE ONE LUG IS FOR GROUND CONNECTION). IN ANY CASE AN EFFECTIVE GROUND CONNECTION MUST BE PROVIDED.

WHERE A THREE-PRONG GROUNDING TYPE PLUG IS USED, THE EQUIPMENT WILL BE GROUNDED THROUGH THE GROUND PRONG PROVIDED THAT THE RECEPTACLE ITSELF IS EFFECTIVELY GROUNDED THROUGH A LOW IMPEDANCE GROUND CONNECTION.

ON INSTRUMENTS EQUIPPED WITH A TWO-PRONG PLUG AND GROUNDING CLIP, A THREE CONDUCTOR LINE CORD TERMINATED IN LUGS, OR WHERE A TWO-PRONG ADAPTER IS USED ON A THREE-PRONG PLUG, THE GROUNDING CLIP OR LEAD MUST BE CONNECTED TO A LOW IMPEDANCE EARTH GROUND. FOR A LOW IMPEDANCE EARTH GROUND, A CONTINUOUS METALLIC UNDERGROUND WATER SYSTEM MAY BE USED FOR GROUND CONNECTION. WHERE THIS IS NOT AVAILABLE A DRIVEN GROUND ROD MAY BE USED TO PROVIDE AN EFFECTIVE EARTH GROUND. IN EITHER CASE THE RESISTANCE TO GROUND OF THE PIPING SYSTEM OR DRIVEN GROUND ROD SHOULD NOT EXCEED 25 OHMS AS REQUIRED BY THE NATIONAL ELECTRICAL CODE.

SOME INSTRUMENTS ARE EQUIPPED WITH A SAFETY GROUND TERMINAL IN ADDITION TO THE GROUNDING CONDUCTOR IN THE LINE CORD. THIS TERMINAL SHOULD BE CONNECTED TO AN AUXILIARY GROUNDING ELECTRODE, HAVING LOW IMPEDANCE, SUCH AS A PIPING SYSTEM OR DRIVEN GROUND REFERRED TO ABOVE. THIS TERMINAL SHOULD BE CONNECTED TO GROUND WITH HEAVY WIRE.

IF TEST EQUIPMENT IS BEING USED IN THE FIELD WHERE INPUT POWER IS PROVIDED BY A GASOLINE ENGINE DRIVEN ALTERNATOR, GENERATOR, OR A BATTERY OPERATED CONVERTER, IT IS ESSENTIAL THAT NOT ONLY THE TEST EQUIPMENT BUT ALSO THE METALLIC FRAMEWORK OR HOUSING OF THE POWER SOURCE BE GROUNDED.

FAILURE TO COMPLY WITH THE ABOVE EQUIPMENT GROUNDING INSTRUCTIONS COULD RESULT IN DANGEROUS ELECTRICAL SHOCK TO OPERATING PERSONNEL.

MODEL 445 - A.C. HYPOT

OPERATING INSTRUCTIONS

H.V. TESTING

1. Place POWER switch in OFF position.
2. Plug INPUT CABLE into a 115 volt, single phase, 60 cycle outlet.
3. Rotate the VOLTAGE control knob to its ZERO position (full counter-clockwise position).
4. Place H.V. - BURN switch in the H.V. position.
5. Place the 1.5 KVA - 3.6 KVA switch in the desired power output position.
6. Place POWER switch in ON position.
7. Apply the H.V. CABLE and GROUND CABLE test prods to the item to be tested.
8. Depress PUSH BUTTON on the H.V. test prod and rotate the VOLTAGE control clockwise until the desired test voltage is indicated on the K.V. meter. If the insulation of the item under test fails, the POWER switch will trip OFF.
9. To re-energize the instrument, repeat steps number 3, 6, 7 and 8.

BURN TESTING

1. When using the instrument for BURN testing, the 1.5 KVA - 3.6 KVA selector switch is rendered inoperative and its position has no bearing on the output. The trip out feature of the POWER switch is also rendered inoperative although it must be in the ON position.
2. Follow steps number 1, 2, 3 and 4 under H.V. TESTING.
3. Place H.V. - BURN switch in the BURN position.
4. Place POWER switch in ON position.
5. Apply the H.V. CABLE and GROUND CABLE test prods to the item to be tested.
6. Depress PUSH BUTTON on the H.V. test prod and rotate the VOLTAGE control clockwise until the desired BURN power is reached. The higher the setting of the VOLTAGE control (that is, the further it is turned clockwise) the more power available for BURNING.

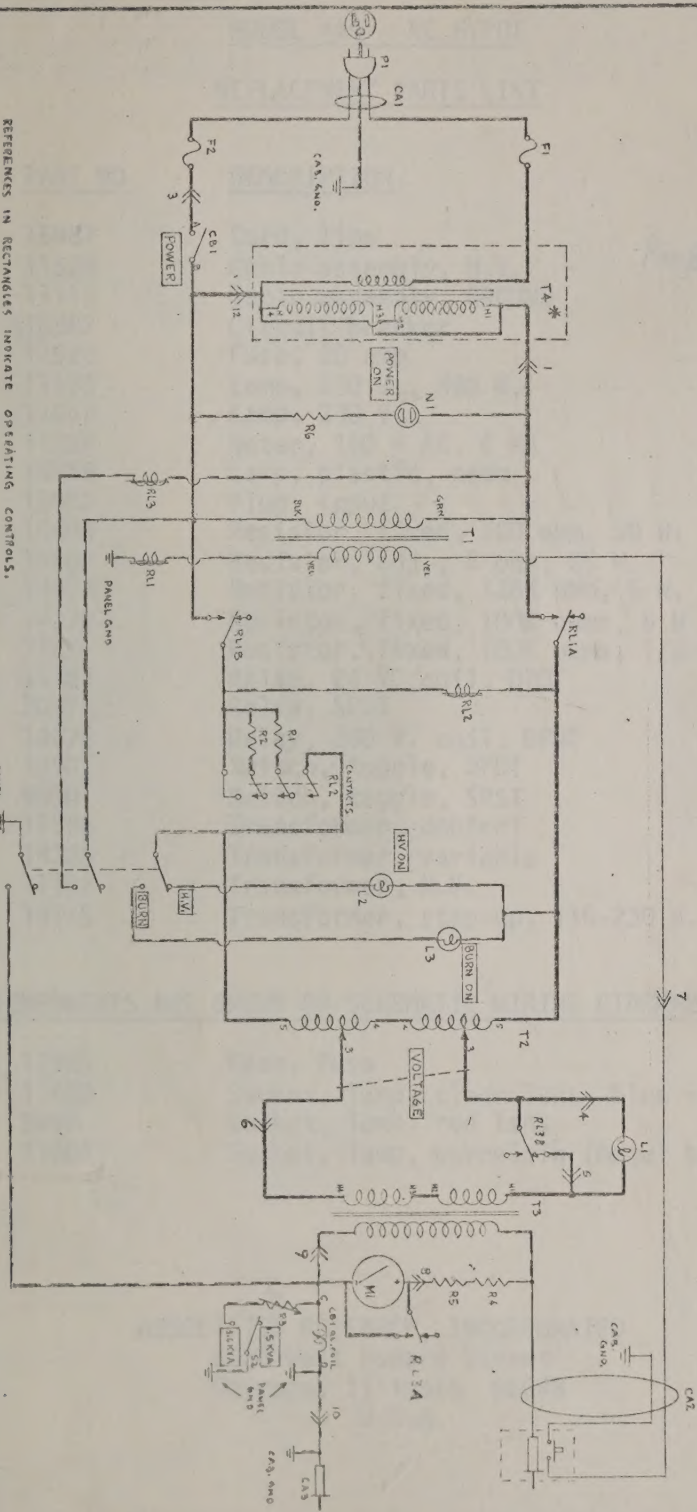
ASSOCIATED RESEARCH, INCORPORATED

Chicago, Illinois, U.S.A.

Q-1237
June 9, 1972

NG NO CWD A-4797

USED ON
445-A-50
447-A-3



REFERENCES IN RECTANGLES INDICATE OPERATING CONTROLS.

——— INDICATE PANEL/CABINET DISCONNECT PLUG DESIGNATIONS.

ALL PANEL GROUNDS ARE TO BE CONNECTED TO A COMMON POINT.

ALL CABINET GROUNDS ARE TO BE CONNECTED TO A COMMON POINT.

SEE DWG NO CPL D 4798 FOR REPLACEMENT PARTS LIST.

——— INDICATES #14 STRANDED WIRE

——— INDICATES #20 STRANDED WIRE

* FOR MODEL 445: CONNECT PRIMARY WINDING OF T4 FOR 115 VOLTS.
SECONDARY WINDING FOR 230 VOLTS.
FOR MODEL 447: CONNECT PRIMARY WINDING OF T4 FOR 440 VOLTS &
SECONDARY WINDING FOR 230 VOLTS

LET	CHANGE	DATE	BY	APP
D	Changed CA1 & P1 to 135-43-W7-3 from P1737 & P1057 with cap.	6-7-54		
C	Added note * re: T4 primary connections	6-18-54		
B	Added wiring notes & front 7 disconnect	5-7-63		
A	ORIGINAL ISSUE	12-28-62		

TOL. FRACT. ±
DECIMAL ±
SCALE
MAT'L
FINISH
TOOLS

ASSOCIATED RESEARCH, Incorporated
"Precision Instruments Since 1938"
3758 WEST BELMONT AVENUE • CHICAGO 18, ILLINOIS

SCHEMATIC WIRING DIAGRAM
MODEL 445-447 HYPOT

DWN. | APP
CKD. | SHT. 1 OF 1

DWG. NO. CWD A-4797-C

MODEL 445 - AC HYPOT

REPLACEMENT PARTS LIST

SYMBOL	PART NO.	DESCRIPTION
CA-1	16987	Cord, line
CA-2	11524	Cable assembly, H.V.
CA-3	11113	Cable assembly, GROUND
CB-1	18882	Circuit breaker
F-1,2	11928	Fuse, 20 amp
L-1	11120	Lamp, 230 V., 500 W.
L-2,3	11052	Lamp, 230 V.
M-1	14398	Meter, 150 V AC, 6 MA
N-1	10568	Lamp, plastic, neon
P-1	18962	Plug, input
R-1	10506	Resistor, fixed, 100 ohm, 50 W.
R-3	19608	Resistor, adj., 2 ohm, 25 W.
R-4	14373	Resistor, fixed, 125K ohm, 5 W. (3 in series)
R-5	14372	Resistor, fixed, 100K ohms, 5 W
R-6	7031	Resistor, fixed, 100K ohms, 1/2 W
RL-1	14327	Relay, 24 V. coil, DPDT
RL-2	20174	Relay, SPST
RL-3	14328	Relay, 230 V. coil, DPDT
S-1	10607	Switch, toggle, 3PDT
S-2	9690	Switch, toggle, SPST
T-1	11386	Transformer, control
T-2	14326	Transformer, variable
T-3	11108	Transformer, H.V.
T-4	18145	Transformer, step-up, 115-230 V.

Probe handle #11352 / Button

COMPONENTS NOT SHOWN ON SCHEMATIC WIRING DIAGRAM

11929	Base, fuse
11409	Socket, lamp, clear lens, blue insert
9492	Socket, lamp, red lens
11087	Socket, lamp, porcelain (mogul base)

ASSOCIATED RESEARCH, INCORPORATED
6125 West Howard Street
Chicago, Illinois 60648
U.S.A.

BULLETIN 10-1.9

Sept. 1974

ASSOCIATED RESEARCH, INC.

INSULATION TESTING INSTRUMENTS

for electronic equipment and systems

Insulation Resistance Testers

Ranges from 100 to 10 million megohms at test potentials to 10 KV.

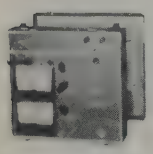
The MEG-CHEK® megohmmeter provides a wide selection of battery and line-powered instruments for accurate insulation resistance measurements of circuits, components, cables, motors, etc. They are direct reading and push button operated requiring no cranking or leveling.

Select from 17 models ranging from pocket-size to portable 10 KV with variable voltage. Some models combine megohm with ohm and AC-DC volt scales in one instrument. Five popular models are:

Model	DC Test Voltage	Max. Megohms	Features
2001	500	100	Pocket-size
2201	500	200	Includes 2K ohm and six AC-DC volt scales
2211	1000	2000	200 K ohm range
2850	500/50	10 Million	Constant test voltage through 6 decades
2955	0-2,500	50,000	Adjustable test voltage

Request MEG-CHEK Megohmmeter Bulletins by model number.

Portable DC HYPOTS® to 200 KV



Output of the several portable DC HYPOTS is continuously variable from 0 to maximum with the voltage metered directly in the output. Leakage current measurements are on four range meters reading down to as low as 0.05 microamps. Features: 2% metering accuracies, electronic circuit protection, by-pass and metered return terminals, grounded steel cases, silicon rectifiers, plug-in high voltage leads, etc.

Model	Output Voltage	Output Current
5205	0-5 KV	2.0
5212	0-10 KV	2.0
5220	0-15 KV	2.0
5471	0-50 KV	5.0
5321	0-100 KV	5.0

Request Portable DC HYPOT Bulletins

Portable Precision Ohmmeter

0-50,000 ohms

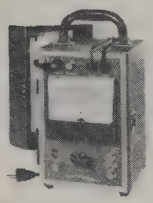
Accurate to 1/2 of 1%.

Model 244 provides ranges 0-50/500/5000/50000 ohms with readings as low as 0.05 ohm. Compensation provided for lead resistance and battery aging, giving ½ of 1% center scale accuracy.

Model 244

Request Bulletin 16-1.3

A-C HYPOT Jrs... to 10 KV, limited current



Portable a-c dielectric strength testers providing outputs continuously variable from 0-1500 V up to 10,000 V a-c. Use of neon breakdown and leakage current indicators in conjunction with collapsing field-type high voltage transformers assures rapid and safe production testing.

The leakage current indicator is adjustable from 0.3 to 3 ma. A 4½" kilovoltmeter provides high accuracy. Short-circuit current cannot exceed 18 ma.

Three popular models are:

Model	Output Voltage
411	0-2,500
404	0-4,000
422	0-10,000

HYPOT Jr. Automatic "Squawker" Models

Available with output voltages from 0-1500 volts to 0-6000 volts a-c. Similar to the standard HYPOT Jr. models but include an audible signal unit and external control terminals.

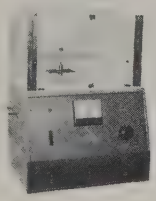
Request Bulletin 4-1.3.

DC and Combined AC/DC HYPOT Jrs.

offer same features as described above, plus test potentials to 5 KV.

Request AC & DC HYPOT Jr. Bulletins.

Insulating Materials Testers



A full range of testers for solid and liquid insulating materials to 100 KV and higher is available. Due to the rapid progress of insulating materials and testing techniques, new equipment is added whenever required to meet ASTM, MIL and Federal test specifications.

Model 4501 Materials Testing HYPOT 0-35 KV at 2 KVA

This popular model meets dielectric strength testing requirements of Specification D-149, ASTM Standards on Electrical Insulation Materials. Output continuously variable from 0-35 KV a-c at 2 KVA (intermittent rating). Magnetic breaker trips when specimen breaks down. Output termination in jacks at center of the lucite cabinet top accepts the interchangeable ARI materials testing fixtures. Optional features: interlocked clear lucite test cage and selection of ARI plug-in materials testing fixtures, automatic rate of rise, dual sensitivity circuit breaker, etc.

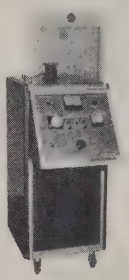
Request Insulation Materials Tester Bulletin

High Voltage Test Equipment to 500 KV AC and 1,000 KV DC

A full range of instruments for extra high voltage dielectric strength testing. AC or DC potentials at capacities of up to 150 KVA or more. Control and measurement features include: automatic rate of voltage rise, memory circuit to record breakdown voltage, output current metering, separate low voltage control and high voltage test cabinets and many others.

ARI has over 30 years experience in the design and manufacture of heavy duty very high voltage test equipment. All instruments are ruggedly constructed and fully tested in our own high voltage laboratory.

Corona Testing Equipment



New instruments detect, display and measure corona caused by voids, surface or other conditions in the insulation sample or the equipment under test.

Instruments include: specially constructed corona-free HYPOT test set, a pickup network to extract the true corona signal and the corona detection display module. Detector also incorporates a calibrator to make quantitative corona measurements down to 0.1 picocoulombs.

These modules are available as individual units or as a complete integrated instrument. Standard models with test potentials of 10 to 100 KV AC include these two popular models:

Model	Output KV	KVA Capacity	Cabinet Style
4074	10	0.25	Bench
4309	35	1.0	Console

Request Bulletin 4-1.9.

Mobile HYPOTS . . . to 150 KV DC

Heavy-duty mobile test sets for determining insulation leakage and dielectric strength of cables, bushings, switch-gear, transformers, motors and generators.

Outputs continuously variable from 0 to 45 KV and on up to 150 KV, with ratings of 2.5, 5, 10 ma. at full voltage.

Features include: 4½" kilovoltmeter connected directly across the high voltage output; three-range 4½" microammeter electronically protected against overload; zero return interlock; connector for remote safety interlock; fast-acting magnetic circuit breaker in output to protect high voltage circuits and external load; thermal overload breaker to protect input circuits; long-life silicon high voltage rectifiers; metered return and bypass return terminals for measurement of load (leakage) or bypass (guard) currents.

Request Mobile DC HYPOT Bulletin 5-1.16.

FREE TESTING INSTRUMENT MANUAL

Write on your company letterhead for a free copy of the 60-page Manual 2900 containing bulletins, specs, application data and prices on the instruments covered above.

INSULATION TESTING INSTRUMENTS

for cables, generators and utility equipment

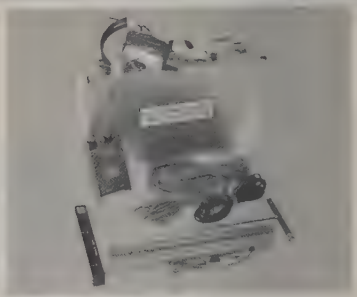
AR ASSOCIATED RESEARCH, INC

BULLETIN 10-1.9

Sept. 1974

HV DC CABLE TESTERS
50, 100, 160 and 200 KV
rugged, field portable models.
Ask for Bulletin 5-1.20.

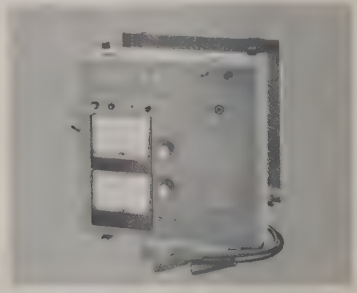
CABLE LOCATOR/FAULT FINDER
for URD secondary cables.
Ask for Bulletin 5-1.23.



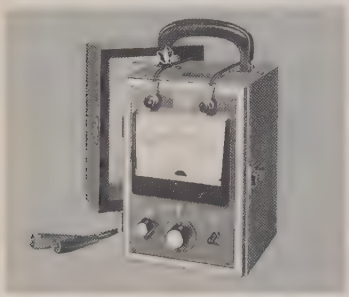
CABLE & PIPE TRACER
Trace energized & de-energized cable.
Trace metal pipe. Determine depth.
Ask for Bulletin 5-1.24.

FAULT DETECTORS
Magnetic and acoustical.
Ask for Bulletin 5-10.23.

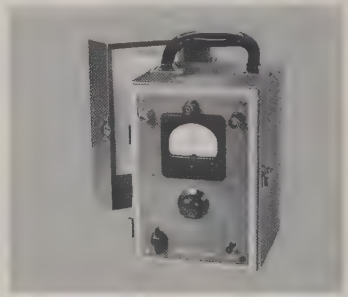
3, 5 & 15 MFD HYJOULE®
High energy "Thumper" cable fault locators. 25 KV DC power.
Ask for Bulletin 5-1.21.



HV MEGOHMMETERS
For testing high voltage equipment. Three models with 2.5, 5 and 10 KV potential. *Ask for Bulletin 2-1.8.*



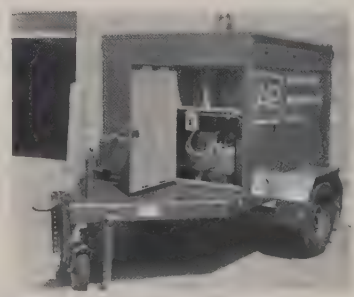
MEG-CHEK® MEGOHMMETERS
For insulation resistance testing at 500 or 1000 VDC.
Ask for Bulletin 2-1.9.



VIBROGROUND®
For measuring resistance of ground rods and systems.
Ask for Bulletin 1-1.5.

5, 10 & 15 KV DC HYPOTS®
For testing motors and equipment rated to 4160 VAC.
Ask for Bulletin 5-1.22.

PHASE SEQUENCE INDICATOR
Identifies phase sequence on 90-700V circuits. New 2500V model also available.
Ask for Bulletin 7-1.4.



CABLE TESTING TRAILER
Complete with 5KW generator, HYJOULE® Fault Locator, HV DC HYPOT & related test instruments.

FREE 60-PAGE MANUAL

Manual D-62 covers specs, application data and prices on the test instruments for HV cables, generators and utility equipment as illustrated above.
For your copy request Manual D-62 on your company letterhead.

AR ASSOCIATED RESEARCH, INC

Instruments for measuring: • Insulation resistance . . . the MEG-CHEK® • Ground resistance — soil resistivity . . . the VIBROGROUND® • High Voltage breakdown, AC-DC . . . The HYPOT® • Cable Fault location . . . the HYJOULE® • Special instrumentation for laboratory, production, and maintenance needs.

6125 WEST HOWARD STREET • CHICAGO, ILLINOIS 60648 • Phone: 312/647-7850

Sales representatives in principal cities

Printed in

In 1936 . . . .

Associated Research, Inc. first opened its doors as a two man electrical meter repair laboratory. Within the year the company expanded into the design and manufacture of specialized meters and electrical testing equipment. From this beginning, ARI has grown steadily in product line, reputation and size.

Today we manufacture a variety of instruments that are widely used to test electrical insulation and equipment. Our main product groups, identified by trademarks are:

MEG–CHEK —— instruments (megohmmeters) to measure insulation resistance.

VIBROGROUND —— instruments to measure ground rod resistance and soil resistivity.

HYPOT —— instruments to measure and test the insulation properties of various materials and devices at AC and DC voltages up to one million volts.

HYJOULE —— instruments for high voltage, high energy capacitor discharge cable fault location.

These and related instruments are manufactured in the modern plant pictured above, located on three acres in suburban Niles on the northwest edge of Chicago. This facility also houses the classroom and testing bay for our popular high voltage cable testing/fault finding school and our new ground resistance testing school. Adjacent to the plant is a testing site of over one-half acre containing various buried high voltage cables and grounding rods for realistic school instruction and instrument testing.

Our instruments are sold by the active, well-informed and trained representatives listed on the reverse. They are eager to work with you in the application of our instruments to your electrical testing problems. Please give your nearest rep a call.

REPRESENTATIVES

ALABAMA			
Huntsville 38510	Holman—Lobsinger Co., Inc.	2816 Hilltop Terrace, N.W.	(205) 859-1750
ARIZONA			
Scottsdale 85252	*Sales Engineering, Inc.	P.O. Box 544	(602) 945-5781
CALIFORNIA			
Paramount 90723	*Brenner-Fiedler Associates, Inc.	16210 Gundry Ave.	(213) 531-7222
San Francisco 94103	*California Instrument Co.	351 Tenth St.	(415) 863-0350
COLORADO			
Grand Junction 81501	Sales Engineering, Inc.	3005 Market Way	(303) 243-5518
CONNECTICUT			
No. Haven 06473	*Northeast Reps., Inc.	140 Washington Ave.	(203) 239-2507
FLORIDA			
Miami 33148	*Ludlum Associates Co.	P.O. Box 48-1337	(305) 592-6523
Orlando 32803	Ludlum Associates Co.	P.O. Box 6274	(305) 894-7761
GEORGIA			
Atlanta 30342	Holman—Lobsinger Co., Inc.	5299 Roswell Road, N.E.	(404) 256-9120
ILLINOIS			
Chicago 60648	Factory Office	6125 W. Howard St.	(312) 647-7850
INDIANA			
Indianapolis 46268	*C.M. Buck & Associates, Inc.	6850 N. Guion Rd.	(317) 293-5704
IOWA			
Cedar Rapids 52406	F.C. Clatterbaugh Co.	P.O. Box 21	(319) 364-5557
Des Moines 50301	F.C. Clatterbaugh Co.	P.O. Box 141	(515) 282-3213
MARYLAND			
Bethesda 20014	Bartlett Associates, Inc.	4405 East West Highway	(301) 656-3061
MASSACHUSETTS			
Needham 02192	*Northeast Representatives, Inc.	60 Dedham Avenue	(617) 449-3034
MICHIGAN			
Birmingham 48008	*Electro-Mation Associates	1137 Cole St.	(313) 564-6517
MINNESOTA			
Edina 55435	*The Ainslie Co.	6550 York Ave., South	(612) 920-2996
MISSOURI			
Kansas City 64133	Cleaves-Bessmer-Marietti, Inc.	6314 Overton	(816) 353-6011
St. Louis 63117	*Fitzgerald Sales Co.	7933 Clayton Road	(314) 862-1660
NEBRASKA			
Omaha 68144	F.C. Clatterbaugh Co.	13425 "C" St.	(402) 333-1600
NEW JERSEY			
Palisades Park 07650	Associated Research, Inc.	328 12th Street	(201) 461-0168
NORTH CAROLINA			
Charlotte 28204	*Jake Rudisill Associates, Inc.	P.O. Box 4245	(704) 377-6901
OHIO			
Brecksville 44141	*D & B Engineering Sales Co.	7517 Winding Way	(216) 526-6320
PENNSYLVANIA			
Pittsburgh 15216	*Bollinger & Richards	P.O. Box 8088	(412) 561-2340
Wayne 19087	Bartlett Associates, Inc.	130 W. Lancaster Ave.	(215) 688-7325
TEXAS			
Dallas 75220	*J.Y. Schoonmaker Co,, Inc.	2995 Ladybird Lane	(214) 357-8481
WASHINGTON			
Seattle 98105	*D.A. Olson Company	5001 – 25th Ave., N.E.	(206) 522-6594

ALBERTA			
Calgary T2S 1X6	*Showalter Agencies, Ltd.	2510 – 4th St., S.W.	(403) 269-6411
BRITISH COLUMBIA			
New Westminster	*Showalter Agencies, Ltd.	136 East Tenth Ave.	(604) 524-1434
ONTARIO			
Don Mills M3B 1Z6	*George M. Fraser, Ltd.	180 Duncan Mill Road	(416) 449-6600
QUEBEC			
Dorval H9P2P4	*Instro-Test, Ltd.	590 Meloche Ave.	(514) 631-4449

*These representatives stock our more popular instruments for their local sale and delivery

(OVER)

MP MASTER
MA30109

ASSOCIATED RESEARCH, INC

Instruments for measuring: • Insulation resistance . . . the MEG-CHEK® • Ground resistance — soil resistivity . . . the VIBROGROUND® • High Voltage breakdown, AC-DC . . . The HYPOT® • Cable Fault location . . . the HYJOULE® • Special instrumentation for laboratory, production, and maintenance needs.

6125 WEST HOWARD STREET • CHICAGO, ILLINOIS 60648 • Phone: 312/647-7850

Sales representatives in principal cities

Printed in U.S.A.

Joe GUEIRRO